



Intel® Pentium® M Processor on 90nm Process with 2-MB L2 Cache

Specification Update

June 2004

Notice: The Intel® Pentium® M Processor may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are documented in this Specification Update.

Document Number: 302209-002



INFORMATION IN THIS DOCUMENT IS PROVIDED IN CONNECTION WITH INTEL® PRODUCTS. NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT. EXCEPT AS PROVIDED IN INTEL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, INTEL ASSUMES NO LIABILITY WHATSOEVER, AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO SALE AND/OR USE OF INTEL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. Intel products are not intended for use in medical, life saving, or life sustaining applications.

Intel may make changes to specifications and product descriptions at any time, without notice.

Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them.

The Intel® Pentium® M Processor on 90nm Process with 2-MB L2 Cache may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Contact your local Intel sales office or your distributor to obtain the latest specifications and before placing your product order.

Intel, Pentium, Celeron, Xeon, and the Intel logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

*Other names and brands may be claimed as the property of others.

Copyright © 2004, Intel Corporation



Contents

Revision History	4
Preface	5
Errata	11
Specification Changes	15
Specification Clarifications	17
Documentation Changes	19

Revision History

Revision Number	Description	Date
-001	Initial Release	May 2004
-002	Updated Processor Identification Table	June 2004



Preface

This document is an update to the specifications contained in the documents listed in Table 1.

Table 1. Affected Documents/Related Documents

Document Title	Document Number
<i>The Intel® Pentium® M Processor on 90nm process with 2-MB L2 Cache Datasheet</i>	
<i>IA-32 Intel Architecture Software Developer's Manual</i>	
<i>Volume 1: Basic Architecture</i>	253665
<i>Volume 2A: Instruction Set Reference</i>	253666
<i>Volume 2B: Instruction Set Reference</i>	253667
<i>Volume 3: System Programming Guide</i>	253668

It is a compilation of S-Specs, Errata, Documentation Changes, Specification Clarifications and Specification Changes. It is intended for hardware system manufacturers and software developers of applications, operating systems, or tools.

Nomenclature

S-Spec Number is a five-digit code used to identify products. Products are differentiated by their unique characteristics, e.g., core speed, L2 cache size, package type, etc. as described in the processor identification information table. Care should be taken to read all notes associated with each S-Spec number.

Errata are design defects or errors. Errata may cause the behavior of the Intel® Pentium® M processor on 90nm Process with 2-MB L2 Cache, to deviate from published specifications. Hardware and software, designed to be used with any given processor, must assume that all errata documented for that processor are present on all devices unless otherwise noted.

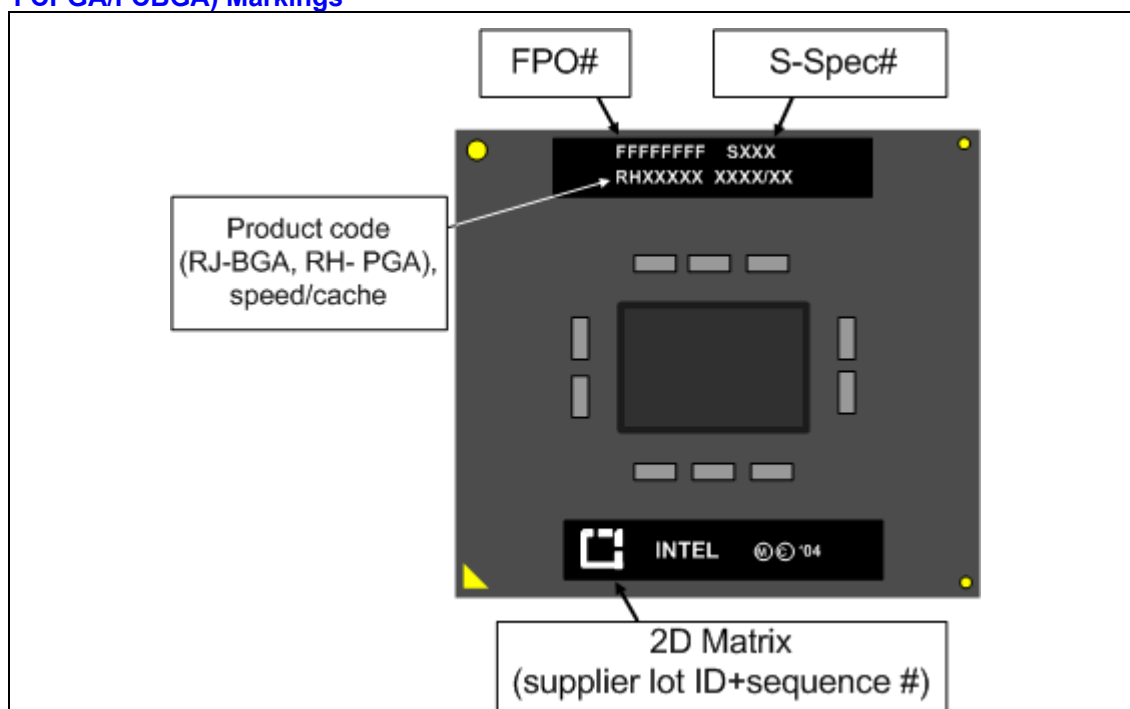
Documentation Changes include typos, errors, or omissions from the current published specifications. These changes will be incorporated in the next release of the specifications.

Specification Clarifications describe a specification in greater detail or further highlight a specification's impact to a complex design situation. These clarifications will be incorporated in the next release of the specifications.

Specification Changes are modifications to the current published specifications for the Intel Pentium M processor. These changes will be incorporated in the next release of the specifications.

General Information

Figure 1. Intel® Pentium® M Processor on 90nm Process with 2-MB L2 Cache (Micro-FCPGA/FCBGA) Markings



Identification Information

The Intel Pentium M processor on 90 nm process with 2-MB L2 Cache can be identified by the following values:

Family ¹	Model ²	Brand ID ³
0110	1101	00010110

NOTE:

1. The Family corresponds to bits [11:8] of the EDX register after Reset, bits [11:8] of the EAX register after the CUID instruction is executed with a 1 in the EAX register.
2. The Model corresponds to bits [7:4] of the EDX register after Reset, bits [7:4] of the EAX register after the CUID instruction is executed with a 1 in the EAX register.
3. The Brand ID corresponds to bits [7:0] of the EBX register after the CUID instruction is executed with a1 in the EAX register.



Table 2. Identification Table

QDF/ S-spec	Product Stepping	CUID	Core Speed		Package	QDF Notes
			Highest Frequency Mode (HFM)	Lowest Frequency Mode (LM)		
SL7EM	B-1	06D6h	2.0 GHz	600 MHz	Micro-FCPGA	1,2
SL7EL	B-1	06D6h	2.0 GHz	600 MHz	Micro-FCBGA	1,2
SL7EN	B-1	06D6h	1.8 GHz	600 MHz	Micro-FCPGA	1,2
SL7EQ	B-1	06D6h	1.8 GHz	600 MHz	Micro-FCBGA	1,2
SL7EP	B-1	06D6h	1.7 GHz	600 MHz	Micro-FCPGA	1,2
SL7ER	B-1	06D6h	1.7 GHz	600 MHz	Micro-FCBGA	1,2
SL7EG	B-1	06D6h	1.6 GHz	600 MHz	Micro-FCPGA	1,2
SL7F2	B-1	06D6h	1.6 GHz	600 MHz	Micro-FCBGA	1,2
SL7GL	B-1	06D6h	1.5 GHz	600 MHz	Micro-FCPGA	1,2
SL7GK	B-1	06D6h	1.5 GHz	600 MHz	Micro-FCBGA	1,2

NOTES:

1. Multiple HFM VID's; VCC_CORE = 1.340-1.276 V for Highest Frequency Mode (HFM).
2. VCC_CORE = 0.988 V for Lowest Frequency Mode (LFM).

Summary Tables of Changes

The following table indicates the Errata, Documentation Changes, Specification Clarifications, or Specification Changes that apply to the processor. Intel intends to fix some of the errata in a future stepping of the component and to account for the other outstanding issues through documentation or specification changes as noted. This table uses the following notations:

Codes Used in Summary Table

Stepping

X: Erratum, Specification Change or Clarification that applies to this stepping.

(No mark) or (Blank Box): This erratum is fixed in listed stepping or specification change does not apply to listed stepping.

Status

Doc: Document change or update that will be implemented.

PlanFix: This erratum may be fixed in a future of the product.

Fixed: This erratum has been previously fixed.

NoFix: There are no plans to fix this erratum.

Shaded: This item is either new or modified from the previous version of the document.

Each specification update item is prefixed with a capital letter to distinguish the product. The key below details the letters that are used in Intel's microprocessor Specification Updates:

- A = Intel® Pentium® II processor
- B = Mobile Intel® Pentium® II processor
- C = Intel® Celeron® processor
- D = Intel® Pentium® II Xeon™ processor
- E = Intel® Pentium® III processor
- G = Intel® Pentium® III Xeon™ processor
- H = Mobile Intel® Celeron® processor at 466/433/400/366/333/300 and 266 MHz
- K = Mobile Intel® Pentium® III processor
- M = Mobile Intel® Celeron® processor
- N = Intel® Pentium® 4 processor
- O = Intel® Xeon™ processor MP
- P = Intel® Xeon™ processor
- Q = Mobile Intel® Pentium® 4 Processor supporting Hyper-Threading Technology on 90-nm process technology
- R = Intel® Pentium® 4 processor on 90 nm process
- T = Mobile Intel® Pentium® 4 Processor-M
- V = Mobile Intel® Celeron® processor on .13 Micron Process in Micro-FCPGA Package
- W = Intel® Celeron® M processor
- X = Intel® Pentium® M processor on 90nm process with 2-MB of L2 Cache
- Y = Intel® Pentium® M processor
- Z = Mobile Intel® Pentium® 4 processor with 533 MHz Front Side Bus

The Specification Updates for the Pentium processor, Pentium Pro processor, and other Intel products do not use this convention.

NO.	B1	Plans	ERRATA
X1	x	No Fix	Code Segment is wrong on SMM Handler when SMBASE is not aligned
X2	x	No Fix	IFU/BSU Deadlock May Cause System Hang
X3	x	No Fix	Memory Aliasing with Inconsistent A and D Bits may Cause Processor Deadlock
X4	x	No Fix	RDMSR or WRMSR to Invalid MSR Address May Not Cause GP Fault
X5	x	No Fix	Unable To Disable Reads/Writes to Performance Monitoring Related MSRs
X6	x	No Fix	Move to Control Register Instruction May Generate a Breakpoint Report
X7	x	No Fix	Error in Instruction Fetch Unit (IFU) Can Result in an Erroneous Machine Check-Exception (#MC)
X8	x	No Fix	Code Fetch Matching Disabled Debug Register May Cause Debug Exception
X9	x	No Fix	Upper Four PAT Entries Not Usable With Mode B or Mode C Paging



NO.	B1	Plans	SPECIFICATION CHANGES
			No Changes

NO.	B1	Plans	SPECIFICATION CLARIFICATION
			None

NO.	B1	Plans	DOCUMENTATION CHANGES
			No Changes

§



Errata

X1. Code Segment Is Wrong on SMM Handler when SMBASE Is Not Aligned

Problem: With SMBASE being relocated to a non-aligned address, during SMM entry the CS can be improperly updated, which can lead to an incorrect SMM handler.

Implication: This is a rare condition that may result in a system hang. Intel has not observed this erratum with any commercially available software or system.

Workaround: Align SMBASE to 32 kB.

Status: For the steppings affected, see the *Summary of Table of Changes*.

X2. IFU/BSU Deadlock May Cause System Hang

Problem: A lockable instruction with memory operand that spans across two pages may, given some rare internal conditions, hang the system.

Implication: When this erratum occurs, the system may hang. Intel has not observed this erratum with any commercially available software or system.

Workaround: Lockable data should always be contained in a single page.

Status: For the steppings affected, see the *Summary of Table of Changes*.

X3. Memory Aliasing with Inconsistent A and D Bits May Cause Processor Deadlock

Problem: In the event that software implements memory aliasing by having two page directory entries (PDEs) point to a common page table entry (PTE) and the Accessed and Dirty bits for the two PDEs are allowed to become inconsistent the processor may become deadlocked.

Implication: This erratum has not been observed with commercially available software.

Workaround: Software that needs to implement memory aliasing in this way should manage the consistency of the Accessed and Dirty bits.

Status: For the steppings affected, see the *Summary of Table of Changes*.

X4. RDMSR or WRMSR to Invalid MSR Address May Not Cause GP Fault

Problem: The RDMSR and WRMSR instructions allow reading or writing of MSR's (Model Specific Registers) based on the index number placed in ECX. The processor should reject access to any reserved or unimplemented MSRs by generating #GP(0). However, there are some invalid MSR addressers for which the processor will not generate #GP(0). This erratum has not been observed with commercially available software.

Implication: For RDMSR, undefined values will be read into EDX:EAX. For WRMSR, undefined processor behavior may result.

Workaround: Do not use invalid MSR addresses with RDMSR or WRMSR.

Status: For the steppings affected, see the *Summary of Table of Changes*.

X5. Unable to Disable Reads/Writes to Performance Monitoring Related MSRs

Problem: The Performance Monitoring Available bit in the miscellaneous processor features MSR (IA32_MISC_ENABLES.7) was defined so that when it is cleared to a 0, RDMSR/ WRMSR/RDPMC instructions would return all zeros for reads of and prevent any write to Performance Monitoring related MSRs. Currently it is possible to read from or write to Performance Monitoring related MSRs when the Performance Monitoring Available bit is cleared to a 0.

Implication: It is not possible to disallow reads and writes to the Performance Monitoring MSRs. Intel has not observed this erratum with commercially available software of system.

Workaround: None.

Status: For the steppings affected, see the *Summary of Table of Changes*.

X6. Move to Control Register Instruction May Generate a Breakpoint Report

Problem: A move (MOV) to Control register (CR) instruction where Control register is CR0, CR3 or CR4 may generate a breakpoint report.

Implication: MOV to Control Register Instruction is not expected to generate a breakpoint report.

Workaround: Ignore breakpoint data from MOV to CR instruction.

Status: For the steppings affected, see the *Summary of Table of Changes*.

X7. Error in Instruction Fetch Unit (IFU) Can Result in an Erroneous Machine Check-Exception (#MC)

Problem: A rare combination of events including the generation of a bus lock(s), the execution of a WBINVD instruction, and a page accessed or dirty bit assist may result in an erroneous Machine Check-Exception (#MC).

Implication: Due to this erratum, unexpected machine check-exception (#MC) is generated. Intel has not been able to reproduce this erratum with commercially available software.

Workaround: It is possible for BIOS to contain a workaround for this erratum.

Status: For the steppings affected, see the *Summary of Table of Changes*.

X8. Code Fetch Matching Disabled Debug Register May Cause Debug Exception

Problem: The bits L0-3 and G0-3 enable breakpoints local to a task and global to all tasks, respectively. If one of these bits is set, a breakpoint is enabled, corresponding to the addresses in the debug registers DR0-



DR3. If at least one of these breakpoints is enabled, any of these registers are *disabled* (i.e., L_n and G_n are 0), and RW_n for the disabled register is 00 (indicating a breakpoint on instruction execution), normally an instruction fetch will not cause an instruction-breakpoint fault based on a match with the address in the disabled register(s). However, if the address in a disabled register matches the address of a code fetch which also results in a page fault, an instruction-breakpoint fault will occur.

Implication: While debugging software, extraneous instruction-breakpoint faults may be encountered if breakpoint registers are not cleared when they are disabled. Debug software which does not implement a code breakpoint handler will fail, if this occurs. If a handler is present, the fault will be serviced. Mixing data and code may exacerbate this problem by allowing disabled data breakpoint registers to break on an instruction fetch.

Workaround: The debug handler should clear breakpoint registers before they become disabled.

Status: For the steppings affected, see the *Summary of Table of Changes*

X9. Upper Four PAT Entries Not Usable With Mode B or Mode C Paging

Problem: The Page Attribute Table (PAT) contains eight entries, which must all be initialized and considered when setting up memory types for the Pentium M processor. However, in Mode B or Mode C paging, the upper four entries do not function correctly for 4-Kbyte pages. Specifically, bit 7 of page table entries that translate addresses to 4-Kbyte pages should be used as the upper bit of a 3-bit index to determine the PAT entry that specifies the memory type for the page. When Mode B ($CR4.PSE = 1$) and/or Mode C ($CR4.PAE$) are enabled, the processor forces this bit to zero when determining the memory type regardless of the value in the page table entry. The upper four entries of the PAT function correctly for 2-Mbyte and 4-Mbyte large pages (specified by bit 12 of the page directory entry for those translations).

Implication: Only the lower four PAT entries are useful for 4-KB translations when Mode B or C paging is used. In Mode A paging (4-Kbyte pages only), all eight entries may be used. All eight entries may be used for large pages in Mode B or C paging.

Workaround: None.

Status: For the steppings affected, see the *Summary of Table of Changes*

§





Specification Changes

There are no Specification Changes in this Specification Update revision.

§





Specification Clarifications

There are no Specification Clarifications in this Specification Update revision.

§



Documentation Changes

There are no documentation changes in this Specification Update revision.